



Water Quality Fact Sheet

Lake Traverse

Bois de Sioux River

Reservoir and Watershed Characteristics

Lake Traverse Reservoir is situated along the boundary of Western Minnesota, NE South Dakota and SE North Dakota. The reservoir is controlled by two dams forming two lakes. White Rock Dam, which forms Mud Lake, is located at the extreme north end of the project and controls water flowing north on the Bois de Sioux River. Reservation Dam controls the pool level at Lake Traverse and the water flowing north into Mud Lake; it also serves as a levee that separates the two lakes.

The lake surface area at normal summer pool elevation (976 ft. msl) is 11,528 acres with a mean depth of 8 feet and the approximate volume is 92,000 acre-feet. The annual inflow volumes range from several lake volumes to amounts that are less than the net evaporation. The year- to-year exchange rate (ie. annual flushing), being highly variable, significantly affects water quality especially sulfate and other dissolved.

The total watershed area contributing to Lake Traverse is 1,497,000 acres. The Mustinka River subbasin represents about 75% of the total watershed. Most of the watershed has sparse vegetation with few trees. Lake Traverse itself is surrounded mostly with farm fields and pastures. The northern and southern ends are bordered with marsh vegetation and willow and cottonwood stands.

Environmental and Water Quality Concerns

In Lake Concerns

Elimination of most of the native prairie, woodlands, and riparian communities and drainage of wetlands for crop production, intensive grazing of livestock on highly erodable hillsides, and construction of the two dams have contributed to significant modification of lake and stream environments through siltation, loading of nutrients and agricultural chemicals, and elimination of normal water level fluctuation. Manifestations of these effects in Lake Traverse include dense blue-green algae blooms, depressed dissolved oxygen levels, and winter fish-kills. High turbidity, sustained by wind-driven resuspension of fine sediment, blocks sunlight which inhibits vegetation and preempts the establishment of littoral habitats, including suitable spawning sites for game fish and pan fish. Lake Traverse is listed by the Minnesota Pollution Control Agency as 'non-supporting' for swimming due to bacterial contamination.

Downstream Concerns

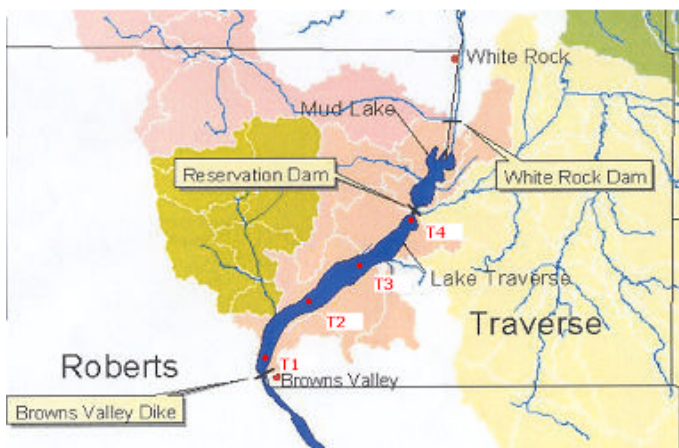
State resource agencies and downstream communities have identified and attempted to address numerous issues that are directly or indirectly associated with Lake Traverse dam operations. Several problems are yet to be resolved. These include:

- High sulfate and total dissolved solids (TDS) concentrations affecting water treatment efficiency and effectiveness
- Objectionable taste and odor experienced by municipal water users
- Low dissolved oxygen
- High water temperatures
- High ammonia concentrations associated with decaying algae and vegetation
- High algae density
- High suspended solids concentrations
- Bio-accumulation of toxic methyl-mercury in game fish

Corps of Engineers Water Quality Monitoring

The Corps samples water at Lake Traverse at two monitoring stations (T4 and T3, **Figure 1**) four times per year during the summer months and occasionally during the winter. Monitoring parameters include; field measurements of temperature, dissolved oxygen, pH, and specific conductance, and laboratory analysis for nutrients, chlorophyll (algae abundance), suspended solids, organic carbon, and sulfate. The data is available for viewing and download through the Water Control Web Site at <http://www.mvp-wc.usace.army.mil/wq/>.

Figure 1
Water Quality Monitoring Locations



Summary of Chlorophyll and Nutrients Data

Limnologists generally evaluate the state of nutrition or “trophic state” of a lake by observing the summer mean concentrations of chlorophyll a, total phosphorus, and secchi disk transparency, and calculating the Carlson’s Trophic State Index (TSI). (See Carlson’s Trophic State Index <http://www.pca.state.mn.us/water/lakeacro.html>)

Figure 2 presents the record of observed summer chlorophyll concentrations in at the primary sampling station in Lake Traverse for the past 15 years and describes a hypereutrophic condition. The mean summer concentration is 61 micrograms/liter. The CHLA TSI is 71 based on 69 observations.

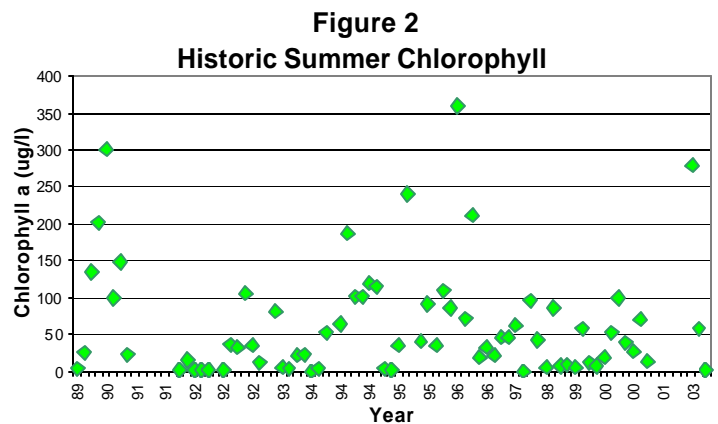
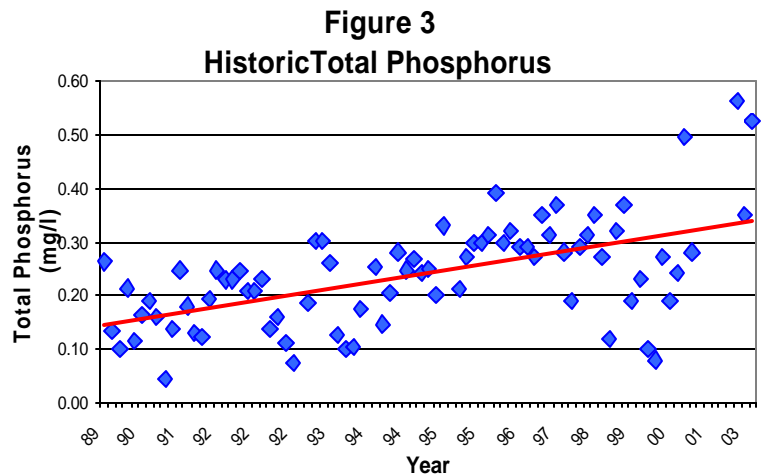
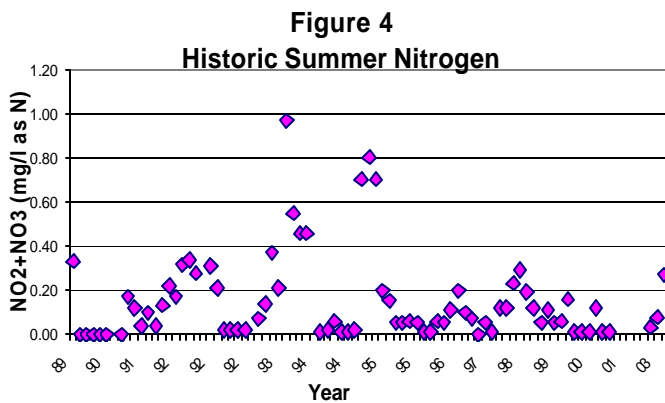


Figure 3 presents the record of observed total phosphorus concentrations for the same period.



The mean summer concentration is 230 micrograms/liter. The TP TSI of 82 based on 76 measurements confirms the hypereutrophic condition. The regression plot indicates a significant upward trend and the approximate doubling of total phosphorus. The lack of a corresponding trend in the chlorophyll record suggests that algae productivity has not been limited by phosphorus availability.

Figure 4 presents the record of summer nitrite/nitrate concentrations. In many eutrophic lakes that are *nitrogen limited* this bio-available form of nitrogen is close to zero or is undetectable during the summer growing season. The relatively high summer values in Lake Traverse suggest surplus availability of nitrogen for algae and plant growth.

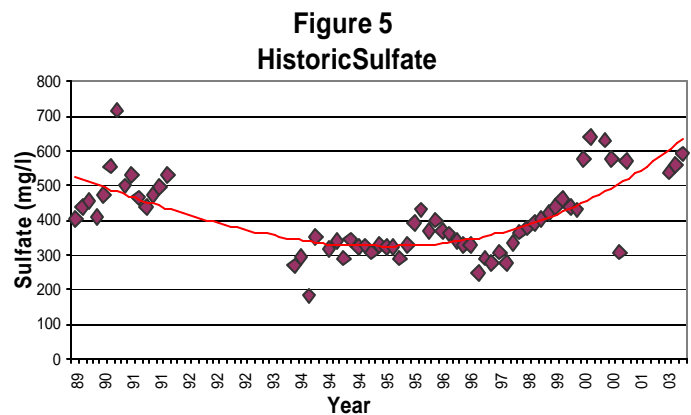


Summary of Sulfate and TDS data

The high sulfate and TDS (total dissolved solids) concentrations that occur in Lake Traverse probably do not affect aquatic life or recreational use of the lake but significantly affect downstream municipal and industrial water users and likely contribute to water treatment costs and taste and odor concerns in the Fargo/Moorhead area. The condition stems from the natural geochemistry of basin soils and groundwater and is not caused by human activity. Human activity in the form of reservoir regulation, however, determines the timing and volume of Lake Traverse waters occurring at the water users’

intakes. Much has been said, done, and attempted by the Corps in cooperation with state and municipal agencies to balance or seek compromise between conflicting needs for flood protection and reliable sources of high quality water. Issues remain, however, and it is clear that enlightened management strategies are still needed especially as continuing development in the basin increases the demand for clean water and flood protection.

Figures 5 and 6 present the sulfate and total dissolved solids (TDS) record for the past 15 years. The sulfate and TDS concentrations are presently at about 600 mg/l and 850 mg/l respectively, a condition comparable to that of West Bay Devils Lake. State water quality standards for the Red River of the North for sulfate and TDS are 250 mg/l and 500 mg/l respectively. Exceedances of those standards, as frequently observed at Fargo, are attributable, in part, to Lake Traverse reservoir operations. The pattern of decreasing and increasing concentrations, shown in the plots, relates to



regional climatic variability. The periods of high concentrations correspond to drought years in which inflow volumes were small relative to lake volume, allowing high evaporation rates to concentrate the dissolved solids. Conversely, high-flow years provide enough inflow to flush out the “aging” water from prior years. The 1997 flood, for example, produced enough inflow to flush out the lake four times (**Figure 7**) while in other years inflow volumes barely matched or were exceeded by evaporation volumes.

Figure 6
Historic Total Dissolved Solids

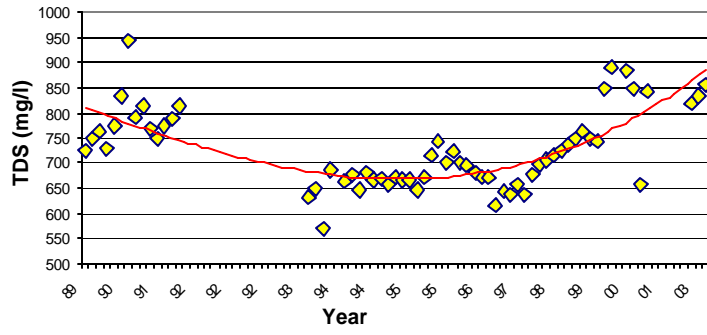


Figure 7
Annual Hydraulic Exchange Rate

